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Tracking of Overweight and Obesity in Greek Youth

Alexandra Veltsista Christina Kanaka Artemis Gika Vasso Lekea Eleftheria Roma Chryssa Bakoula

1st Department of Pediatrics, University of Athens, Aghia Sophia Children's Hospital, Athens, Greece

Keywords

Adolescents · Children · Overweight · Obesity · Prevalence · Tracking

Summary

Objectives: The aim of this study was to determine the prevalence and tracking of overweight and obesity in a representative sample of Greek youth and the relation with child and parental factors. **Methods:** Data were derived from 2 follow-ups of the Greek 1983 National Perinatal Survey by means of a questionnaire completed by parents in 1990 and parents/adolescents in 2001. Parent- and self-reported height and weight measurements were available for 7,219 participants aged 7, and 2,842 participants aged 18. **Results:** The overall overweight/obesity prevalence was 24.3% at age 7, and 15.1% at age 18. The overweight prevalence increased from childhood to adolescence in boys (16.1 to 19.1%) and decreased in girls (19.2 to 8.0%), while the obesity prevalence showed a decrease in both boys (6.2 to 3.6%) and girls (5.8 to 1.0%). Overall, tracking of weight status was 73.7%. More boys (49.2%) remained overweight/obese than girls (24.7%). At age 7, overweight/ obesity was positively associated with male gender, paternal education, and urban residence. Overweight/obesity also correlated with male gender at age 18, and with parental weight status. **Conclusions:** The prevalence of overweight among Greek youth is high and showed an increase from childhood to adolescence in boys, and a decrease in girls.

Introduction

Obesity has become a global issue since there are numerous indications that a greater number of children and adolescents are becoming overweight each year [1]. Childhood obesity is of great concern because obese children are at increased risk to remain obese in adulthood or experience long-term adverse health consequences, such as dyslipidemia, hypertension, type 2 diabetes, metabolic syndrome, cardiovascular disease [2]. In Greece, increasing trends in the proportion of overweight children have been observed [3, 4]. Indications of the magnitude of the problem in Greece compared to other countries point towards a particularly high prevalence of overweight and obese youth, particularly boys, exceeding 20%, as in North America and other Southern European countries [5–7]. Recently published results in Greek elementary schoolchildren living in Northeast Attica, using the International Obesity Taskforce (IOTF) criteria, indicated a 27.8% prevalence of overweight and 12.3% prevalence of obese boys, while in young Greek men the corresponding figures were 28.5 and 10.4% [8, 9]. Researchers considered that many overweight or obese schoolboys remained overweight or obese throughout adolescence into their young adult life [8]. Nonetheless, epidemiological information is lacking as these findings pertained to different population samples, and robust conclusions could not be drawn. In fact, to our knowledge, there is no published data examining changes in the proportion of children classified as overweight or obese for a nationally representative sample of Greek youth. Therefore, we aimed to assess the prevalence of overweight and obesity in a population-based sample of Greek children at the age of 7 and 18 years (two critical periods for developing obesity) [10], and to examine changes in the proportion of children classified as overweight or obese from childhood to adolescence. Finally, we examined the association between a child's weight status at 7 and 18 years and gender, place of residence, parental education, television viewing, physical activity patterns, and parental weight status.

KARGER

Fax +49 761 4 52 07 14
Information@Karger.de
www.karger.com

Accessible online at:
www.karger.com/ofa

Dr. Alexandra Veltsista
1st Department of Pediatrics, University of Athens
Aghia Sophia Children's Hospital
Athens, 11527, Greece
Tel: +30 21074671-34, Fax -59
alexveltsista@in.gr

Material and Methods

The methods of selection and follow-up of the cohort have been previously described [11–13] and are summarized briefly.

Study Design and Population

A total of 11,048 neonates, that represented 8% of the country's annual births, were recorded nationwide from the 1st to the 30th of April 1983 and constituted a representative, population-based sample [11]. Children were followed up through 2 separate questionnaire surveys conducted in 1990 and 2001. The first follow-up survey was conducted through 3,445 primary schools. From the 9,000 questionnaires sent out, a total of 8,158 completed questionnaires were returned (74% response rate), of which 6,643 questionnaires were successfully merged with corresponding data in 1983. A second follow-up was again made to locate participants through 6,200 high-schools throughout the country. Of the 4,675 questionnaires distributed, 3,500 responded (75% response rate). For each survey, the questionnaires were kept anonymous. Furthermore, due to the fact that the Greek adolescent participants responded to the questionnaire shortly before their university entry examinations, the attrition was relatively high. Nevertheless, sensitivity analyses showed that the follow-up data was well representative of the initial Greek birth cohort from whom it was selected [12, 13]. The participants contacted in 2001 did not differ significantly from participants lost to follow-up in background factors such as living area, mother's marital status or birth weight, but girls were slightly overrepresented, and parents' social class was slightly higher in the follow-up group than in the sample lost to follow-up. To limit any bias, the analysis included gender and parental education as covariates, or was conducted separately for boys and girls. Furthermore, taking into account the gender, urban living, and socioeconomic distribution of the adolescent sample recruited in 2001 on the basis of the same year census, it could be considered a representative sample of the Greek adolescent population [12, 13]. All studies were approved by the National Hellenic Research Foundation, the Ministry of Education and Health, and the National Privacy Principles Board. Informed consent was obtained from all participants or their parents prior to each survey.

Questionnaires and Measures

In 1990, a questionnaire was completed by the participants' parents. Parents were asked the child's height and weight, their degree of education (grouped as ≤ 6 years of schooling, schooling from 7 to 12 years, > 12 years of schooling to indicate socioeconomic status), region of residence (classified as urban with > 10,000 people, semi-urban with 2,000–9,999 people, and rural with < 2,000 people), the child's physical activity, and frequency of watching television. Parents were asked how many hours in a typical week children were physically active (with sports, school activities), and how many hours per day they watched television in their free time on a typical weekday and weekend (an average number of hours per week and hours per day were used respectively as an index of physical activity and television viewing). Participants were grouped according to their parents' responses. Data on parents' weight and height were not collected during this period. During 2001, the participants, now adolescents, completed the questionnaire themselves while at the same time, a second questionnaire was addressed to their parents. These questionnaires collected data on parental and adolescent weight and height (self-reported by each), adolescents' physical activity participation, and hours of television viewing. Participants were asked how many times during the past year they were physically active (activities included sports, walking, dancing), and possible responses were never, once a month or less, 2–3 times a months, once a week, 2–3 times a week, and 4 or more times a week. The average number of days per week was calculated and grouped into: never/hardly ever, 1–3 times a week, 4 or more times a week. Because anthropometric measurements of weight and height were available for a small subsample of adolescents in 2001, we used self-reported measures only. This is clearly a limitation to this study, although comparative analysis of the clinical measurements obtained and self-reported data showed no significant differences (data not shown). The international BMI reference proposed by the IOTF for defining overweight and obesity for children and adolescents aged 2–18 years was used to determine youth's weight status at 7 and 18 years of age [14]. Overweight parents had $30 > BMI \geq 25$ kg/m^2 and obese had BMI ≥ 30 kg/m^2. The term overweight for children and adolescents in this report did not include obese participants. For parents overweight and obesity status were grouped.

Non-Respondents

We included only children with available weight and height measurements at 7 and 18 years of age to determine the corresponding prevalence of overweight and obesity. To determine whether the youth who did not report their height and weight at the age of 7 years were comparable to those who did, we compared eating-related behaviors between these groups. There were no significant differences in eating behaviors, such as being fussy ($p = 0.10$) or eager with food ($p = 0.38$), between those whose parents did report compared to those whose parents did not report height and weight at 7 years. Furthermore, to determine whether the youth who did not report their height and weight at the age of 18 years were comparable to those who did, we compared weight controlling and fear of getting fat between these groups. Similar percentages of those who reported compared to those who did not report height and weight at 18 years used some form of weight control (47 vs. 45% in boys, 56 vs. 57% in girls) and were not afraid of putting on weight (67 vs. 66% in boys, 88 vs. 85% in girls). Finally, to examine changes in the proportion of children classified as overweight or obese, we compared the weight status of the 7-year-olds that responded to the 2001 survey compared to non-respondents, and found the response rates were similar for overweight and obese boys and girls at 7 years of age ($p = 0.16$ for boys, and $p = 0.09$ for girls). Furthermore, participants with follow-up information on weight and height compared to those without were equally likely to have an urban background (72 and 71.9%, Pearson's χ^2 test $p = 0.93$) and mothers with similar mean BMI before pregnancy (mean BMI for the mothers was 21.10 kg/m^2 (standard deviation (SD) 3.82) and 21.0 kg/m^2 (SD 3.84) ($p = 0.29$). Although the mothers of the children with available follow-up information compared to those lost to follow-up were slightly more educated and the fathers' social class was slightly higher ($p < 0.001$ for both), all levels of education and social classes were adequately represented in the longitudinal data.

Statistical Methods

All statistical analyses were performed using SPSS for Microsoft Windows version 13.0 (SPSS Inc., Chicago, IL, USA), and statistical significance was set at $p \leq 0.05$. The prevalence of overweight and obese children and the association with place of residence, parental education, physical activity,

Table 1. Prevalence of overweight and obesity in Greek children at the age of 7 and 18 years

Age, years	Total population					Boys					Girls				
	n	overweight	%	obese	%	n	overweight	%	obese	%	n	overweight	%	obese	%
7	7,219	1,269	17.6	431	6.0	3,744	601	16.1	231	6.2	3,475	668	19.2	200	5.8
18	2,842	368	12.9	63	2.2	1,291	246	19.1	48	3.6	1,551	122	7.9	15	1.0

Table 2. Relationship between BMI classification in childhood and adolescence

At age 7 classified as	Number of 18-year-olds (%) being											
	total population				boys				girls			
	non-overweight	overweight	obese	overweight/obese	non-overweight	overweight	obese	overweight/obese	non-overweight	overweight	obese	overweight/obese
Non-overweight	1,281 (90.5)	121 (8.6)	13 (0.9)	134 (9.5)	555 (84.3)	92 (14.0)	11 (1.7)	103 (15.7)	726 (95.9)	29 (3.8)	2 (0.3)	31 (4.1)
Overweight	263 (71.9)	90 (24.6)	13 (3.6)	–	88 (58.3)	53 (35.1)	10 (6.6)	–	175 (81.4)	37 (17.2)	3 (1.4)	–
Obese	13 (49.0)	13 (36.0)	15 (15.0)	–	13 (29.5)	20 (45.5)	11 (25.0)	–	36 (64.3)	16 (28.6)	4 (7.1)	–
Overweight/obese	312 (67.0)	–	–	154 (33.0)	101 (51.8)	–	–	94 (48.2)	211 (77.9)	–	–	60 (22.1)

hours of television viewing, and parental weight status were studied, for the total population and both genders separately, with descriptive and inferential analyses. Due to the small number of individuals in the obesity subgroup, especially in adolescent girls, we combined them with the overweight individuals for further analysis. Chi-squared tests were used to analyze the stability of each subgroup (non-overweight, overweight, obese) between 7 and 18 years of age with and without the overweight and obese subgroups combined. Multivariable logistic regression analysis was then used to examine the association between the binary status of overweight and obesity and the variables identified as significant in univariate analyses, as well as known biologically and socially important variables. The odds ratios (ORs) and 95% confidence intervals (CI) are reported.

Results

For the present study, questionnaire data were examined for 7,219 7-year-olds (3,744 boys, 3,475 girls) and 2,842 18-year-olds (1,291 boys, 1,551 girls) with reported weight and height at the corresponding time points to determine the prevalence of overweight and obesity. Table 1 shows the prevalence of overweight and obesity in the total population, and by age and sex. At the age of 7 years, the prevalence of overweight children was 17.6% and obese 6.0%. The levels were similar for both genders in childhood, given that overweight boys and girls were 16.1 and 19.2%, respectively, and obese boys and girls were 6.2 and 5.8% each ($p = 0.3$). Yet, during adolescence boys had a significantly higher prevalence of overweight and obesity than girls (19.1 vs. 8.0%, and 3.6 vs. 1.0% respectively; $p < 0.001$).

The tracking of subgroups showed that overall 73.7% of the 7-year-olds retain their classification of weight status at 18 years ($\chi^2 = 215.77$, $p < 0.001$). For the obesity categories, 24.6% of the overweight 7-year-olds remained overweight at 18 years of age, and 15.0% of the obese 7-year-olds remained obese at the age of 18 years. However, there was a significant difference in the trends followed by each gender. In particular, 35.1% of the overweight boys and 25.0% of the obese boys at 7 years of age remained overweight and obese, respectively, during adolescence. The corresponding rates among girls were only 17.2 and 7.1% (table 2). This results mainly from a greater shift from overweight/obesity in childhood to normal weight in adolescence among girls (77.9%) than among boys (51.8%). These data reveal that overweight/obesity persisted in 48.2% of the boys and only in 22.1% of the girls ($p < 0.001$ for both).

Differences in the factors studied across normal-weight, overweight, and obese groups are shown in tables 3 and 4. A clear relationship was found between obesity and overweight at 7 years of age and both place of residence and activity hours per week in boys. More exactly, in urban areas, the prevalence of overweight boys was higher than in the rural areas, while a higher percentage of obese boys were found to engage in 3 or more hours of sport activities per week than the overweight and normal-weight. There was also a clear relationship between children's nutritional status and hours of television viewing at 7 years of age, whereby a higher percentage of obese children watched more than 3 hours of television

Table 3. Child and parental characteristics and corresponding prevalence of BMI classification at 7 years of age

	Total population (n = 7,219), %			p	Boys (n = 3,744), %			p	Girls (n = 3,475), %			p
	non-overweight	overweight	obese		non-overweight	overweight	obese		non-overweight	overweight	obese	
Place of residence				0.11				0.02				0.88
Urban	75.6	18.2	6.2		76.4	17.2	6.4		74.8	19.3	6.0	
Semi-urban	76.7	17.8	5.5		78.1	17.1	4.8		75.5	18.4	6.1	
Rural	78.9	15.8	5.3		81.6	12.8	5.6		75.5	19.5	5.0	
Mother's education level				0.33				0.07				0.93
Up to 6 years	77.8	16.8	5.4		80.1	15.0	4.9		75.4	18.7	5.9	
7–12 years	75.6	18.2	6.3		76.5	16.8	6.7		74.6	19.6	5.8	
More than 12 years	75.9	17.8	6.3		76.4	16.4	7.2		75.3	19.4	5.3	
Father's education level				0.07				0.08				0.29
Up to 6 years	78.4	16.3	5.4		80.3	14.7	5.0		76.3	18.0	5.7	
7–12 years	76.3	17.5	6.2		77.2	16.4	6.3		75.3	18.6	6.1	
More than 12 years	74.8	19.0	6.2		75.8	17.0	7.2		73.6	21.3	5.1	
Hours of television viewing				0.008				0.04				0.18
Up to 3 h/day	76.6	17.7	5.6		78.0	16.2	5.8		75.1	19.4	5.5	
More than 3 h/day	75.4	16.5	8.1		76.5	14.9	8.6		74.2	18.2	7.6	
Physical activity				0.45				0.03				0.71
None	76.7	17.6	5.8		78.2	16.0	5.7		74.7	19.5	5.8	
1–2 h/week	75.3	18.5	6.3		77.3	15.9	6.8		74.4	19.5	6.1	
3 or more h/week	75.9	16.7	7.4		73.2	16.4	10.4		78.1	16.9	5.0	

Table 4. Adolescent and parental characteristics and corresponding prevalence of BMI classification

	Total population (n = 2,842), %			p	Boys (n = 1,291), %			p	Girls (n = 1,551), %			p
	non-overweight	overweight	obese		non-overweight	overweight	obese		non-overweight	overweight	obese	
Place of residence				0.19				0.15				0.91
Urban	85.0	13.2	1.8		78.1	19.1	2.8		91.2	7.9	0.9	
Semi-urban	83.4	13.2	3.3		73.9	20.4	5.7		91.6	7.1	1.2	
Rural	85.9	12.2	1.9		79.3	17.3	3.4		90.4	8.7	0.9	
Mother's education level				0.61				0.43				0.98
Up to 6 years	84.9	12.9	2.2		76.4	19.7	4.0		91.2	8.0	0.8	
7–12 years	84.1	13.3	2.6		75.7	20.0	4.3		91.2	7.7	1.2	
More than 12 years	86.2	12.2	1.6		80.5	17.1	2.4		91.4	7.8	0.8	
Father's education level				0.15				0.12				0.84
Up to 6 years	85.3	12.6	2.1		76.6	20.1	3.3		91.9	7.0	1.1	
7–12 years	83.7	13.6	2.7		75.2	19.9	4.9		90.8	8.3	0.9	
More than 12 years	86.8	11.9	1.2		80.6	17.4	2.0		92.2	7.2	0.6	
Hours of television viewing				0.81				0.72				0.16
Up to 3 h/day	84.9	12.9	2.2		77.0	19.3	3.8		91.5	7.6	0.9	
More than 3 h/day	83.3	14.0	2.7		80.6	16.1	3.2		86.0	11.8	2.2	
Physical activity				0.62				0.88				0.41
None	86.9	11.0	2.1		75.7	19.8	4.5		94.2	5.2	0.6	
1–3 times/week	83.7	13.6	2.7		77.2	18.5	4.3		89.4	9.4	1.2	
4or more times/week	85.2	12.8	2.0		77.5	19.2	3.3		91.6	7.5	0.9	
Parental BMI status				< 0.001				< 0.001				< 0.001
No parents overweight/obese	94.6	5.4	0.0		88.2	11.8	0.0		99.1	0.9	0.0	
One parent overweight/obese	86.2	12.1	1.7		78.3	18.7	2.9		93.6	5.9	0.5	
Two parents overweight/obese	80.3	16.4	3.3		73.1	21.7	5.2		85.9	12.3	1.8	

Table 5. Factors associated with overweight/ obesity in Greek children at the age of 7 and 18 years

	Total population				Boys				Girls			
	7 years		18 years		7 years		18 years		7 years		18 years	
	adjusted OR[a]	95% CI	adjusted OR[a]	95% CI	adjusted OR	95% CI	adjusted OR	95% CI	adjusted OR	95% CI	adjusted OR	95% CI
Place of residence												
Urban	1.15	1.00–1.33	1.06	0.72–1.57	1.29	1.05–1.58	1.13	0.69–1.87	1.03	0.84–1.26	0.97	0.51–1.83
Semi-urban	1.10	0.88–1.38	1.21	0.80–1.85	1.22	0.88–1.69	1.33	0.78–2.27	1.00	0.73–1.36	1.15	0.57–2.34
Rural	1.00		1.00		1.00		1.00		1.00		1.00	
Mother's education level												
Up to 6 years	1.00		1.00		1.00		1.00		1.00		1.00	
7–12 years	1.03	0.89–1.19	1.25	0.88–1.79	1.07	0.88–1.32	1.03	0.67–1.59	0.98	0.81–1.20	1.92	1.00–3.70
More than 12 years	0.97	0.80–1.16	0.93	0.59–1.47	1.07	0.83–1.39	0.81	0.46–1.41	0.88	0.68–1.15	1.25	0.54–2.90
Father's education level												
Up to 6 years	1.00		1.00		1.00		1.00		1.00		1.00	
7–12 years	1.10	0.95–1.28	1.11	0.77–1.61	1.10	0.90–1.36	1.31	0.83–2.05	1.10	0.90–1.35	0.76	0.39–1.50
More than 12 years	1.22	1.03–1.46	1.15	0.75–1.77	1.15	0.90–1.48	1.09	0.64–1.85	1.28	1.00–1.63	1.19	0.58–2.46
Hours of television viewing												
Up to 3 h/day	1.00		1.00		1.00		1.00		1.00		1.00	
More than 3 h/day	0.90	0.77–1.06	0.84	0.47–1.51	0.88	0.70–1.10	0.51	0.23–1.12	0.93	0.73–1.17	2.05	0.85–4.94
Physical activity												
None	1.00		1.00		1.00		1.00		1.00		1.00	
1–3 times/week	0.98	0.81–1.18	1.04	0.63–1.70	0.93	0.65–1.32	0.69	0.37–1.29	1.00	0.79–1.26	2.49	0.97–6.40
4 or more times/week	0.96	0.79–1.17	0.89	0.55–1.43	1.21	0.91–1.60	0.66	0.37–1.19	0.80	0.61–1.06	1.70	0.67–4.31
Parental BMI status												
No parents overweight/obese	–	–	1.00		–	–	1.00		–	–	1.00	
One parent overweight/obese	–	–	3.34	1.79–6.24	–	–	2.79	1.42–5.49	–	–	9.72	1.30–72.96
Two parents overweight/obese	–	–	5.03	2.70–9.38	–	–	3.31	1.67–6.56	–	–	23.60	3.20–174.16

[a]Models adjusted for gender.

per day. Finally, there was a clear association between the nutritional status of children and their parents ($p < 0.001$ for both parents), as overweight and obese parents were more likely to have overweight and obese children than the non-overweight mothers and fathers.

Multivariate logistic regression analysis was conducted with overweight and obesity combined for the total population and for boys and girls separately (table 5). Gender was associated with overweight/obesity, and boys were 1.16 times (95% CI 1.04–1.31) more likely to be overweight/obese than girls at 7 years, and 3.4 times (95% CI 2.51–4.59) more likely to be overweight/obese than girls at 18 years of age. The association between maternal education with overweight/obesity in adolescent girls was found in those whose mothers had a high school level of education (7–12 years) with an OR of 1.92 (95% CI 1.00–3.70). Fathers higher education (college or university level) was positively associated with overweight/obesity in the total population and in girls at 7 years of age, with an OR of 1.22 (95% CI: 1.03–1.46) and 1.28 (95% CI 1.00–1.63), respectively. Urban residence was significantly associated with overweight/obesity in the total population and in boys at 7 years of age, with an OR of 1.15 (95% CI 1.00–1.33) and 1.29 (95% CI 1.05–1.58), respectively. Finally, adolescents who had one overweight/obese parent were 3.34 times (95% CI 1.79–6.24) more likely to be overweight/obese than those whose parents had normal weight, while the association was stronger when both parents were either overweight or obese, with an OR of 5.03 (95% CI 2.70–9.38). In the multivariable model, physical activity and hours of television viewing lacked statistical significance for overweight/obesity.

Discussion

The present longitudinal cohort study has two important findings. First, to our knowledge, there is no previous study to report on the prevalence of overweight and obesity in a representative, population-based sample of Greek 18-year-olds using the IOTF criteria. Second, this is the first study that reports on the tracking of weight status in Greek children from early childhood to late adolescence.

This study revealed a high prevalence of overweight and obese girls and boys at 7 years. The estimate of overweight children was lower than what was observed in a previous study on 6-year-olds in Crete during the same period [15], but the use of non-representative samples, differences in the age groups and in the classification system employed to determine which youth are overweight, can explain part of the differences [7]. The prevalence of overweight and obese children in our study was considerably higher than the prevalence reported by studies conducted in other developed countries, including Iceland, England, Portugal with corresponding age categories, and were comparable to countries such as Canada and the USA [6, 7, 16].

In the present study we found a gender-specific contrast in adiposity patterns from childhood to adolescence. Although there were similar percentages of overweight and obese girls and boys in early childhood, we found a sharp decrease in the proportion of overweight and obese girls during adolescence, but not in boys. In fact, the overall overweight/obesity prevalence was similar in 7- and 18-year-old boys (22.3% in 1990, and 22.7% in 2001), but in adolescent girls the drop was striking. This marked difference probably occurs early in adolescence, according to estimates reported in the Health Behavior in School-Aged Children (HBSC) study, whereby the gap in overweight and obesity rates between Greek girls and boys progressively increased from the age of 13 to the age of 15 years [17]. Similarly, a survey of Greek children 6–12 years of age showed no gender differences in overweight and obesity at the age of 6, but lower rates of overweight and obesity in girls by the age of 12 [15]. It seems that girls are more likely than boys to shift to being non-overweight during adolescence, probably due to body-image concerns and perceptions. On the contrary, boys highly tend to retain their overweight and obese status. Similar findings were reported in surveys done in China [18], Spain [19], Thailand [20], and Brazil [21], but also contradictory observations have been reported [22]. Future research could add to this line of research by exploring possible mechanisms behind these differences.

The multivariate analysis revealed a positive association between maternal and paternal educational level and overweight and obesity, particularly in girls (table 5). There is considerable variability across studies about the direction of the relation between socio-economic status and obesity, particularly among children. These inconsistencies might be due to differences in the age of the participants, the type of study design, the time of the study, and the degree of adjustment for confounders. As in other Southern European countries, Greece experienced remarkable socio-economic changes during the last decades, which brought along changes in people's lifestyle, dietary habits, and physical activity [23, 24]. In the sample reported here, higher maternal and paternal education may reflect an accumulation of improved socio-economic conditions, such as increased availability of high-energy density foods, better quality of household assets, increased access to means of transportation, and less opportunities for exercise, that could be partially associated with the increased rates of obesity. Attesting to this notion, our study showed a significant association between place of residence and overweight and obesity in childhood for boys. Boys from urban areas had higher rates of overweight and obesity than those from rural areas. This could again be attributed to lifestyle factors, but further research should establish the extent to which these determinants can explain the obesity problem in our country.

Our results showed a positive association between parental and child weight status, a finding consistent with other studies [25, 26]. The relationship between parental and child weight status is mediated by a number of factors, both genetic and environmental. Since we found a significant association be-

tween maternal and paternal BMI (data not shown), it is more likely this influence is due to environmental rather than genetic factors.

Our study has several strengths and weaknesses that should be taken into consideration when interpreting its results. Our findings are based on cohort participants willing to take part in a follow-up study, and families may be apt to provide better childbearing conditions than typical of the general population. This may limit the ability to explore the association of overweight/obesity and related factors in the most complete way. However, the large and representative sample of youth is a major advantage that allows a more thorough assessment of the data. Furthermore, cross-sectional analysis of the data limits the ability to draw causal inferences. A priority for future research should be the longitudinal analysis of the associations examined here so that causality can be established. In addition, it is necessary to address the risk of false-positive associations that can be derived from multivariate analysis when many tests are conducted. Thus, our results should be confirmed in future studies. Finally, although BMI was based on self-reported measures of weight and height, studies relating self-reported to measured weight and height suggest that reporting is generally accurate, with no evidence of substantial sex differences [27, 28]. In conclusion, the high prevalence and tracking of overweight and obesity among Greek boys is an important public health problem. Those developing policy and programs for obesity prevention should place more emphasis on appropriate measures in preschool years.

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Disclosure

The authors have no conflicts of interest that are relevant to the content of this article.

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